

Potential Inter-Subbasin Transfer Areas from the Devils Lake Basin

April 2000

The Devils Lake subbasin is a 3,810 square mile subbasin of the Red River of the North Basin. When the level of Devils Lake exceeds 1459 feet msl it discharges through the Tolna Coulee and contributes to the Red River drainage system. Dr. John Bluemle, ND State Geologist, has documented that the lake has exceeded this elevation and contributed to the Red River Basin several times since glaciation. Dr. Bluemle feels that fluctuations in the lake level are normal and that the lake should not be expected to remain at any certain level.

Currently Devils Lake is approximately 13 feet below the elevation at which it will contribute water directly from the lake into the Red River Basin. However, due to the poorly defined drainage divides that exist within the prairie pothole region, water from the Devils Lake watershed is often exchanged with other watersheds without the lake reaching its spill elevation. This report outlines several areas where these hydrologic connections occur between Devils Lake surrounding watersheds.

There are undoubtedly numerous areas where water crosses the currently identified subbasin boundaries. The ND State Water Commission (SWC) has identified four areas where inter-subbasin transfer potentially exists that provides a direct hydrologic connection with Devils Lake: Rock Lake, Billings Lake, McHugh Slough, and an area south and east of East Devils Lake. These areas are shown on Figure 1.

Rock Lake

Rock Lake is located in Towner County near the city of Rock Lake, ND, and is a tributary to the Pembina River. Part of the lake is located within the Rock Lake National Wildlife Refuge. In 1935 the Bureau of Biological Survey, predecessor of the US Fish & Wildlife Service (Service), created the Rock Lake Refuge. As part of the refuge development, various water control projects were undertaken. A dam was constructed in Sec. 28, T162-R66, a road along the north edge of Sec. 12, T162-R67 was raised, and a small dam was constructed on the southeast side of Sec 33, T162-R66 (Figure 2). The dam in Sec. 28 had a top elevation of 1533.0 and was to retain water in the main part of the lake. The road along the north edge of Sec. 12 was used to divert the flow of the Armourdale Coulee into Rock Lake, and the dam in Sec. 33 was to prevent the lake from flowing southeastward onto private lands.

Original surveys of the refuge identified a low area in Sec. 7, T162-R66 and it was assumed that at lake elevations above 1527 feet msl the lake would discharge southward into the Mauvais Coulee. Biological Survey blueprints from the 1930's show Rock Lake and Mauvais Coulee to be connected. Later surveys, however, proved this assumption to be inaccurate as the high point separating the basins was located in Sec. 19, T162-R67 at elevation 1534.0 feet msl.

In 1945-46 the Service constructed a channel through the divide in Sec. 19. A stoplog structure consisting of two bays, each five feet wide by three feet high was placed at the beginning of the

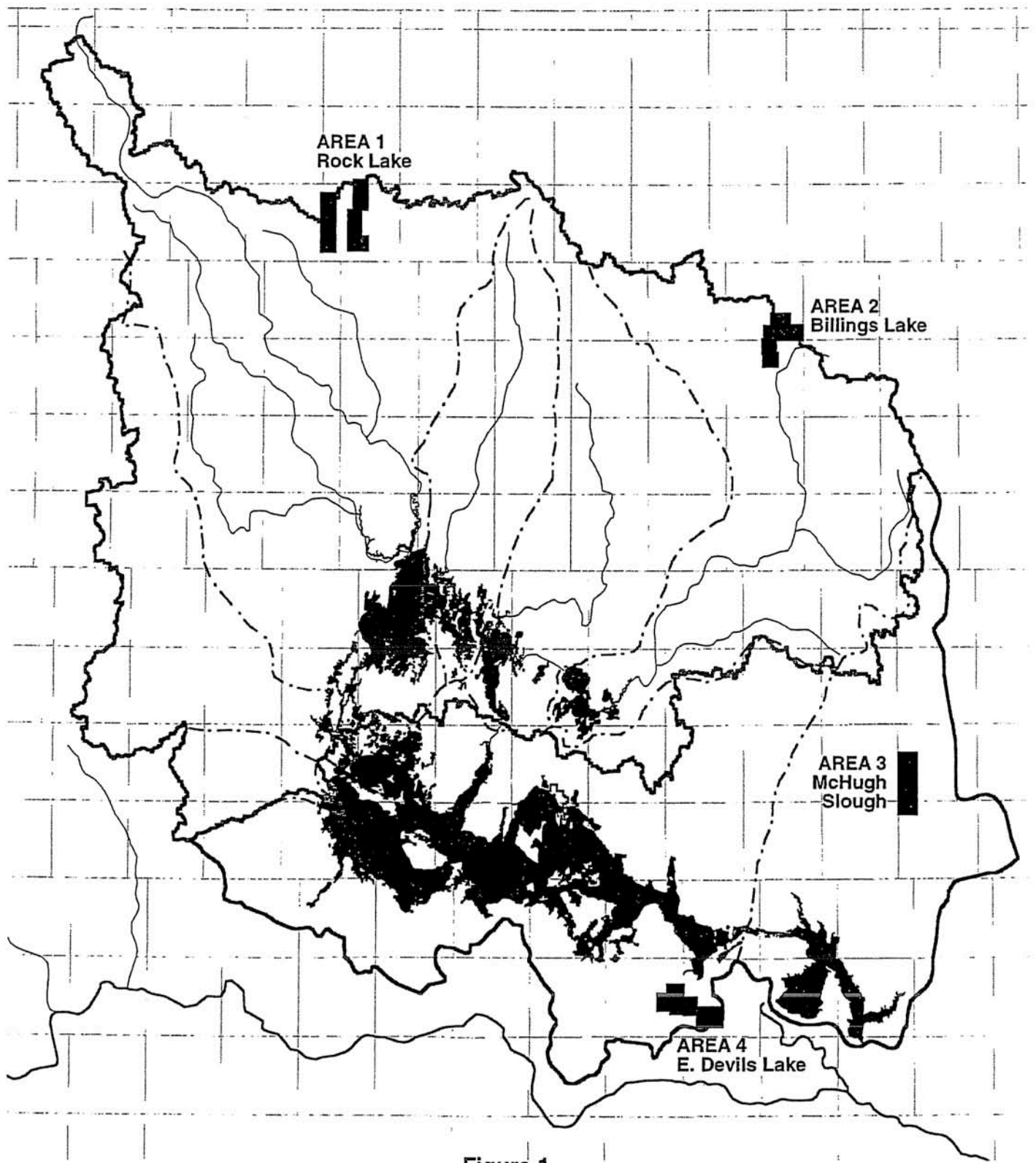
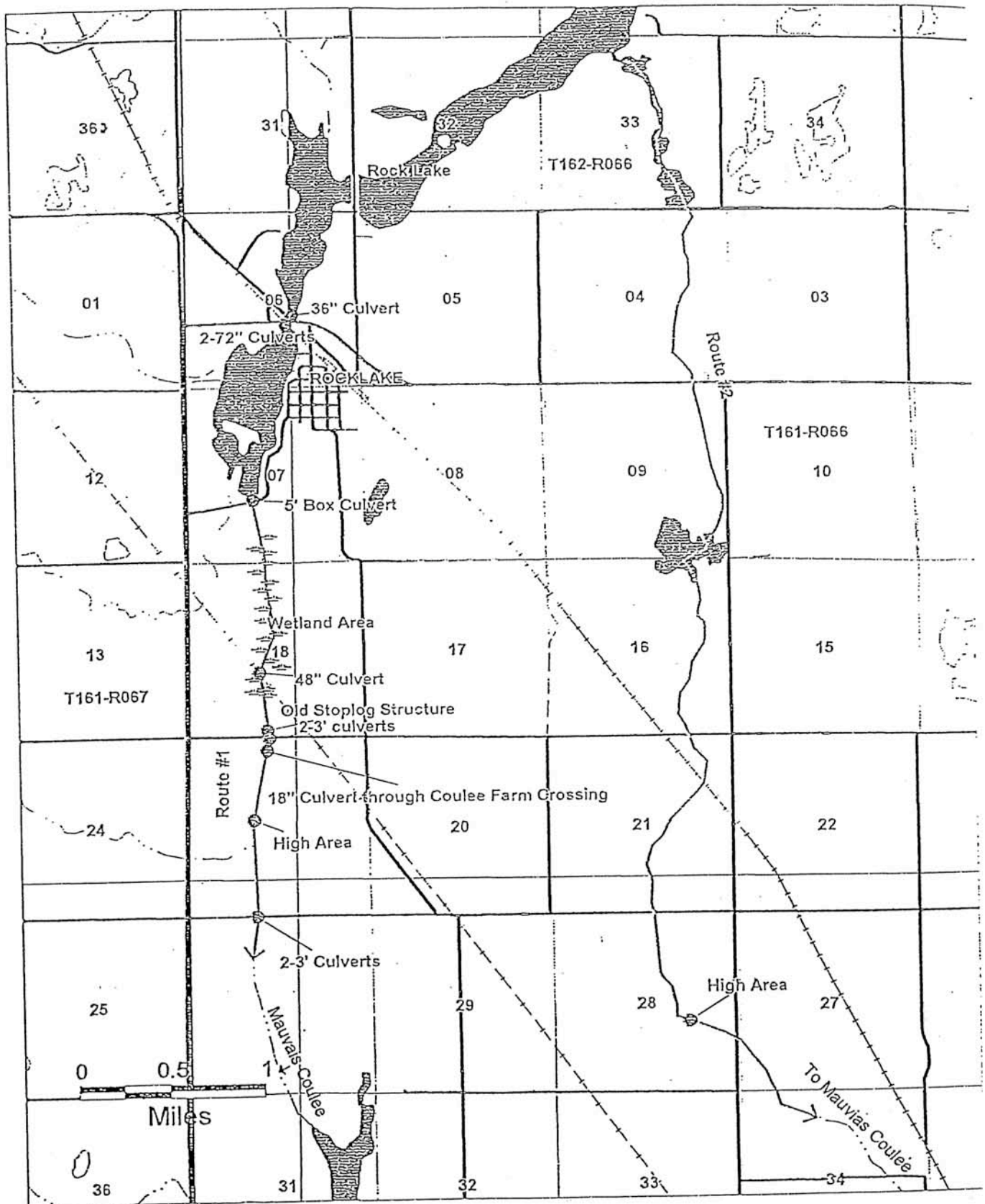


Figure 1
Potential Inter-subbasin Transfer Locations

Figure 2



Possible Rock Lake - Mauvias Coulee Interbasin Transfer

channel at the south end of Sec. 18. The flowline elevation of the structure was 1529.7 and the top of the stoplogs was 1530.7. It was intended that the stoplogs would be removed during periods of low flow to provide water for easement areas downstream, and also provide relief for Rock Lake when water levels exceeded 1530.7. During periods of high water, however, the stoplogs were often removed by individuals not affiliated with the Service as a means of providing flood control for Rock Lake. Landowners near Lake Alice complained about the excess water brought about by construction of the channel and it was subsequently plugged in May of 1955.

In the fall of 1998, the State Water Commission (SWC) survey crew investigated the possibility of inter-subbasin transfer occurring between the Pembina River and Devils Lake through Rock Lake, ND. The attached map outlines the two areas surveyed to identify the possibility of the transfer between Rock Lake and Devils Lake: the channel constructed by the Service (Route #1) and an area east of the city of Rock Lake (Route #2).

The first area surveyed was the previously mentioned channel constructed by the Service in the 1940's to connect Rock Lake to the Mauvais Coulee (Route #1). Water leaving Rock Lake can pass into a large wetland area in Sections 7 and 18, T161-R66 through a 5-foot box culvert located at the south end of Rock Lake. The box culvert appears to drain a coulee located to the west of the wetland area in Sec. 7, T161-R66, but during above average runoff events water levels increase to a point at which the coulee, wetland area, and Rock Lake are connected. Once the water in this wetland rises, it can pass through a 48" culvert in an abandoned railroad running diagonally through Sec. 18, T161-R66. A field investigation showed this culvert to be unobstructed with the exception of some debris in the bottom of the culvert. At the south end of Section 18, 161-66, the wetland narrows into the channel constructed by the Service in the mid-1940's. Located in the channel, just north of an east-west gravel road between Sections 18 and 19 is the stoplog structure constructed by the Service to regulate flows from Rock Lake southward into Mauvais Coulee. During a site visit in May 1998, the logs were in place in the east bay, but were removed in the west bay. Through the road are two 3-foot culverts. South of the road is a channel crossing that provides access for farm equipment to move from one side of the channel to the other. Through this crossing is an 18" culvert.

Approximately 0.5 miles south of the gravel road in Sec. 19, T161-R66 is the block the Service placed in the channel to keep water from flowing south into the Mauvais Coulee. A survey of this area shows the divide to be approximately 200 feet long with a top elevation above 1533 feet msl. This high area appears to decrease the possibility that substantial amounts of water currently flow between Rock Lake and Mauvais Coulee at this location.

Color infrared photos (Figure 3) taken in early June of 1997 identifies the extent of the channel constructed by the Service. Records obtained from the Service prove that this channel provided a conduit for water to pass between Rock Lake and Devils Lake until the channel was plugged in 1955.

The second area investigated to determine the likelihood of inter-subbasin transfer between Devils Lake and Rock Lake begins at the dam the Service placed in the NW¼ of Sec. 33, T162-

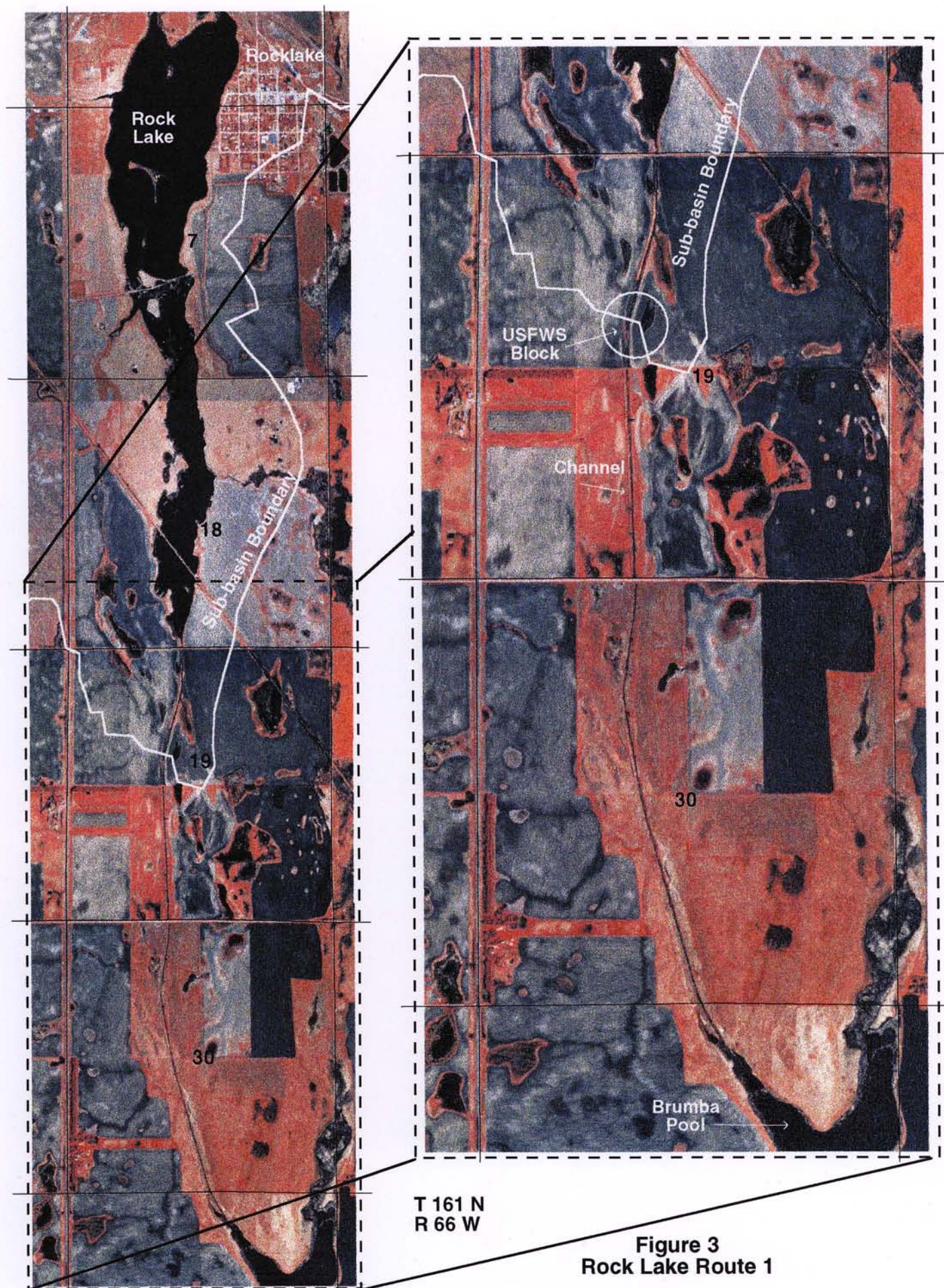


Figure 3
Rock Lake Route 1

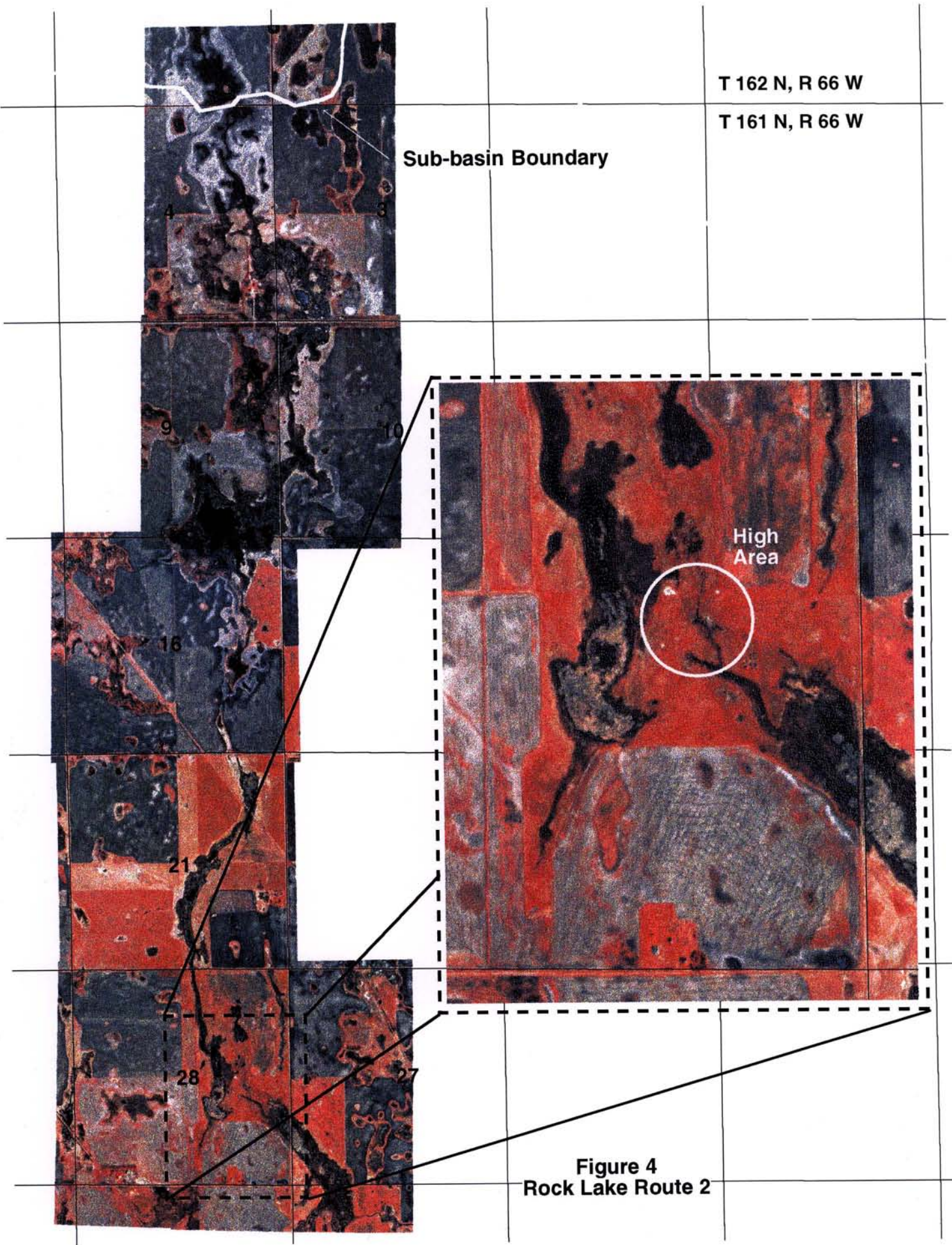
R66 (see Route #2 on attached map). Through the dam are two culverts that normally allow water to drain into the lake, but could allow water to leave the lake when lake levels are high. From the dam the flow would follow a generally south pattern through Sections 4, 9, 16, 21 and 28 all in T161-R66. In Sec. 28 the water would have to pass over a high area before entering a wetland area that drains into the Mauvais Coulee. A survey of the high area along this route shows the divide to be approximately 1530 feet msl, three feet lower than the divide placed by the Service along Route #1. This route is longer and is not a clearly defined channel in many areas. This route also appears to contain many cattails that could restrict the flow. In other areas it appears water would need to cross cultivated fields to make the connection. A more detailed survey of this area is required to document culvert sizes and invert elevations through the dam in Sec. 33, T162-R66, and all roadways and the railroad embankments to better identify the potential amount of water that could be transferred between the watersheds.

Color infrared photos of this area are only available up to the south half of Sec. 33, T162-R66. From this point southward the photos identify a channel that appears to connect Rock Lake to the Mauvais Coulee (Figure 4). According to the Rock Lake elevation graph provided to the SWC by David Leas, former Towner County WRD member, Rock Lake peaked just below 1531 feet msl in the spring of 1997. The same lake level graph shows Rock Lake peaked 1-2 feet higher than its 1997 peak several times since the measurements were started in 1973. Members of the Towner County WRD, as well as State Representative Gene Nicholas, have witnessed water moving between the subbasins. The color infrared photos and lake level information leave little doubt that, during high runoff periods, a connection occurs between Rock Lake and Devils Lake.

Billings Lake

A second hydrologic connection between Devils Lake and the Pembina River is through an area just north of the Billings Lake National Wildlife Refuge, near Loma, ND. Billings Lake outlets directly into the Edmore Coulee, a major tributary to Sweetwater-Morrison Lake and ultimately Devils Lake. According to landowners living in the area, even during average runoff events a tributary to the refuge often flows north into a tributary of Rush Lake. Rush Lake, in turn, outlets through Snowflake Creek into the Pembina River. During the spring, landowners in the area fish near the south end of Billings Lake, catching northern pike weighing up to several pounds. It is the opinion of ND Game & Fish Department staff, that since there are few other sustained water bodies in the area that could support fish year around, the fish ultimately made their way from Devils Lake.

This divide area was just recently brought to the attention of SWC staff and has not been surveyed. Color infrared photos (Figure 5) taken in early June of 1997 confirms that water flows across the divide, connecting the two watersheds. More information is required to better determine the extent of water transfer in this area.



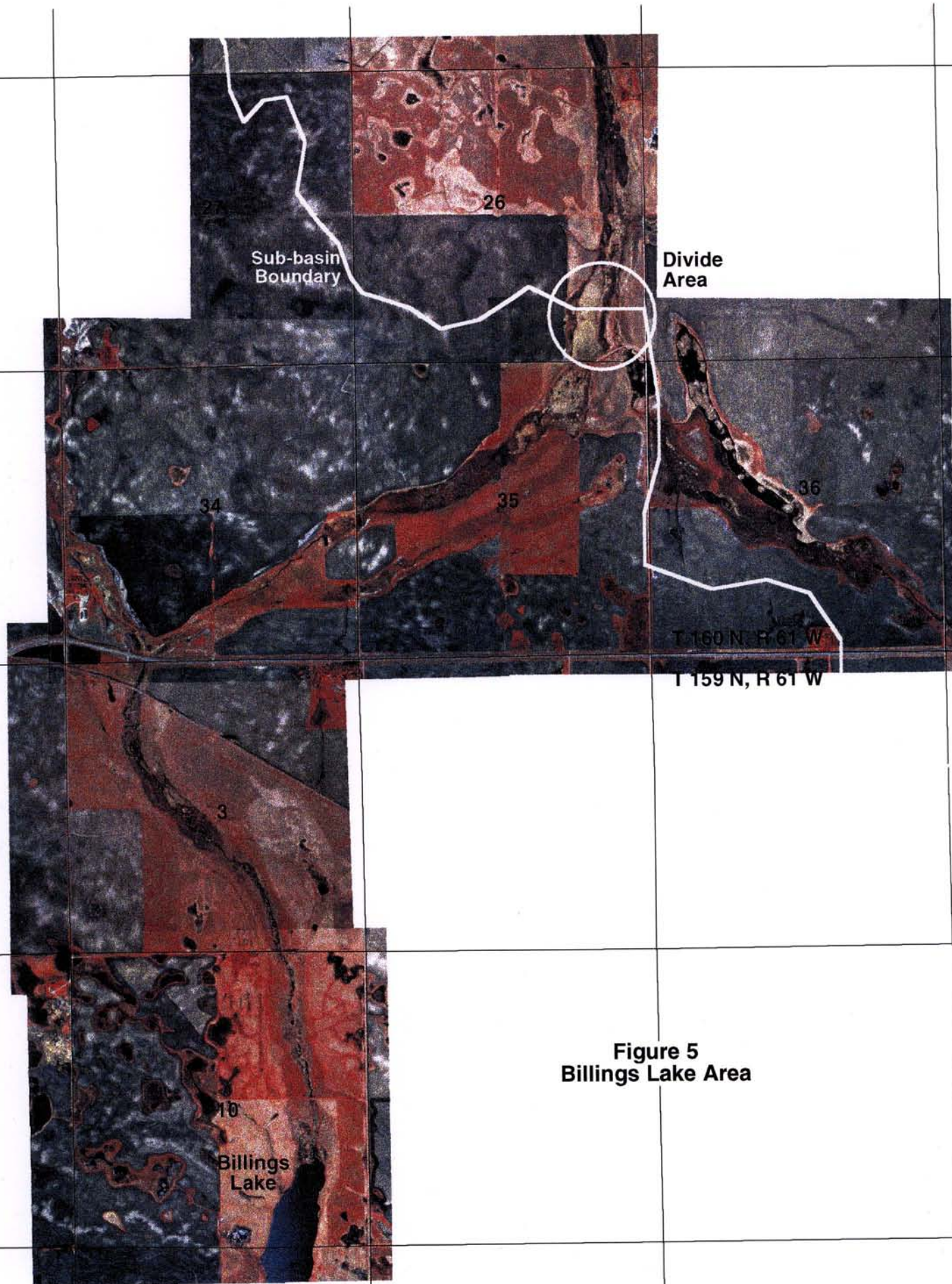


Figure 5
Billings Lake Area

McHugh Slough Area

McHugh Slough is located in Nelson County approximately four miles north and four miles east of Lakota, ND. The topography in this region is very flat and slight fluctuations in water surface elevations of water bodies throughout this area causes inundation of thousands of acres of farmland. Due to the large amount of flooding, this area has been the subject of several reports identifying potential solutions to reduce flooding in the area.

Currently the Nelson County Water Resource District (WRD) is pursuing a pump and channel system that would convey water from McHugh Slough to the Forest River, a tributary of the Red River of the North. As part of this process, the Nelson County WRD hired an engineering consulting firm to develop plans for the project. Upon reviewing the survey of the area, the consulting engineer identified the overflow elevation from McHugh Slough to the Forest River as 1510.2 feet msl. The SWC survey crew surveyed three areas where McHugh Slough could likely overflow to Devils Lake. Results of this survey indicates McHugh Slough would have to exceed 1512 feet msl before spilling to Devils Lake. Therefore, water from the McHugh Slough area was assumed to overflow to the Forest River approximately two feet lower than it would spill to Devils Lake. After reviewing color infrared photos of the area, however, it was noticed that a connection between the Devils Lake Basin, through the Edmore Coulee Tributary (a tributary of Sweetwater-Morrison Lake and ultimately Devils Lake), and McHugh Slough occurs in an area that was not surveyed. This area appears to be lower than the areas surveyed. Thus, the actual divide elevation between McHugh Slough and Devils Lake is unknown.

Another area in which water from McHugh Slough could outlet to the Forest River is through the Enterprise Drain. This drainage project was completed in 1979 to reduce flooding in a large, flat area located approximately nine miles north and three miles west of Michigan, ND. Typically the Enterprise Drain removes water from its approximately 12 square mile watershed, however, when McHugh Slough is at high elevations it could overflow into the Enterprise Drainage system and be discharged to the Forest River. The overflow elevation at which this occurs has not been determined, but according to USGS 7.5 minute quadrangle maps the spill elevation is above 1510 feet msl.

Color infrared photos of this area show a hydraulic connection between McHugh Slough and Devils Lake. These photos were also reviewed to identify a hydraulic connection between McHugh Slough and the Forest River through either the Enterprise drain or by natural overflow, however, a defined flow path to make the connection could not be determined. According to a record of McHugh Slough water surface elevations provided by the Nelson County WRD, McHugh Slough was 1509.56 feet msl on May 12, 1997, and 1509.00 feet msl on July 28, 1997. The color infrared photos were taken June 10, 1997. Therefore, it can be estimated that McHugh Slough was near 1509 feet msl at the time of the photos. According to work completed by the consulting engineer for the Nelson County WRD, McHugh Slough would have to raise approximately one to one and one-half feet before spilling to the Forest River. Since 1997, the level of McHugh Slough has receded slightly and was at elevation 1508.26 feet msl on October 19, 1999. Therefore, it does not appear that a hydrologic connection currently exists between Devils Lake and the Red River Basin at this location.

East Devils Lake

The shortest route that could provide a hydrologic connection from Devils Lake to the Red River is through East Devils Lake. A channel enters East Devils Lake in the southeast 1/4 of Sec. 6, T151-R62. From the lake, this channel proceeds generally southwestward for about 18,000 feet, where it changes direction and runs east for about 24,000 feet, then it turns south and discharges into Black Slough, about 1 mile north of Hamar. Black Slough discharges into the south branch of Tolna Coulee above Snortland Dam.

This area was surveyed by the Bureau of Reclamation in the 1950's. These surveys indicate a divide is located upstream of Black Slough, in the northwest 1/4 of Sec. 28, T151-R62. The elevation of this divide appears to be about 1462 feet msl. This is approximately three feet higher than the other known outlet, that discharges from the western side of West Stump Lake into the North Branch of Tolna Coulee. However, given head losses through the lakes and connecting channels, it is likely that when Devils Lake discharged through Stump Lake, it probably discharged through the Black Slough route as well.

Color infrared photos of this area (Figure 6) indicates that, at present, this outlet conveys only local runoff into East Devils Lake north and west of the divide, and into Black Slough south and east of it. However, during the times it discharged, it would have provided a positive hydraulic connection between the Sheyenne River and Devils Lake. A field survey of this area will be conducted in order to determine the probability of overflow.

Other Potential Pathways for Hydraulic Transfer

Water may cross watershed boundaries from a variety of ways other than overland flow. With the excellent fishery located at Devils Lake, large numbers of boats and fisherman visit the lake daily. Bait buckets, live wells, and bilge pumps all provide a means for transporting water across basin divides. Though this water may not be large quantities, it still allows mixing of waters from different watersheds.

Further evidence about past inter-subbasin transfer is more anecdotal in nature. According to the state geologist Devils Lake was nearly dry a few hundred years ago. At these levels Devils Lake could not have supported fish. However, when early explorers arrived to the region they noted the fish that existed in Devils Lake. Joseph N. Nicollet, who explored the area in 1838-39, wrote in his journal dated August 5, 1839; "We have not been able to make sure what species of fish are in the lake, but our guides and the Indians report that there are numerous and very large species. At the end of a storm our men saw the beach covered with dead red fish and a pike which must have weighed several pounds."

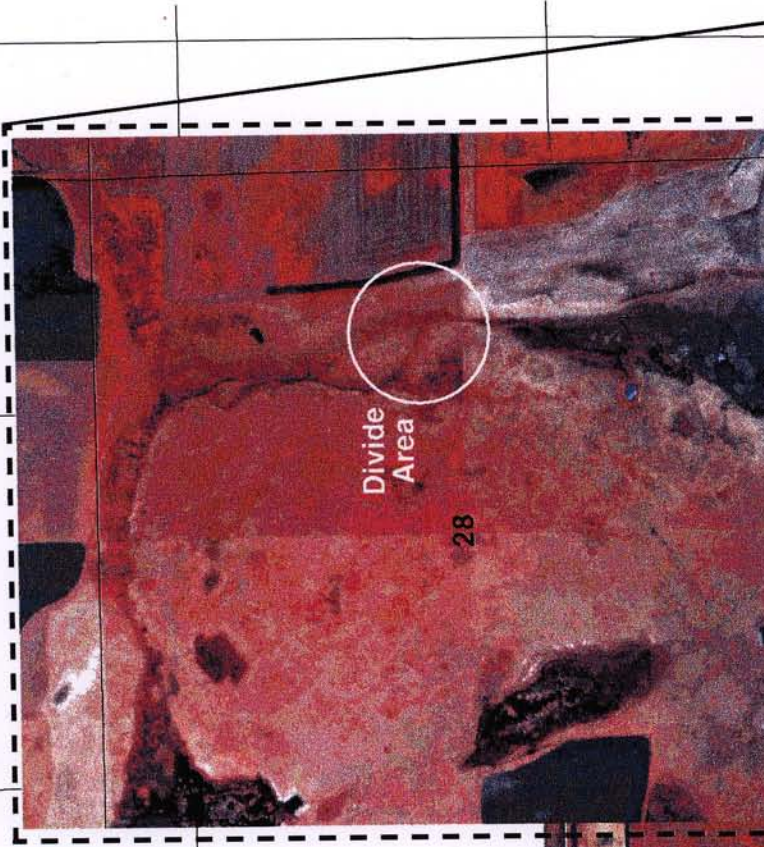
According to information supplied by the ND Game & Fish Department the fishery in Devils Lake during the late 1880's was excellent. A local butcher had a standing order of 1,200 pounds per day. The question then arises, if Devils Lake was nearly dry and could not support fish a few hundred years ago, but had large numbers of fish when the early settlers arrived to the area, where did the fish come from? The Game & Fish Department speculates that fish in the lake

To
Devils Lake



T 151
R 63

T 151
R 62



Divide
Area



Figure 6
East Devils Lake Area

prior to their stocking activities were the result of fish migrating into the lake through inter-subbasin transfer.

Conclusion

From the information currently available, there is clear evidence that water crosses into and out of the Devils Lake subbasin into surrounding watersheds. Although the frequency of such transfers and the amounts and duration of these transfers is unknown, transfers do occur and will likely increase in frequency and duration as the current wet cycle continues. More study is needed to better determine basin divide elevations, topography of routes where the transfer occurs and the size and elevations of culverts that provide the conduit for water to move from one watershed to another.